REMARKS

Informalities

In the Office Action mailed on April 19, 2006, the Examiner objected to certain claims due to informalities in their language. This specifically refers to claims 7, 11, and 16. Applicants have amended those claims according to the recommendations of the Examiner, and thus these objections should now be obviated. Applicants appreciate the Examiner's helpful suggestions in this regard.

The above amendments to the claims are being made solely for the purpose of overcoming § 112 objections by the Examiner; the amendments are not for a reason related to patentability in view of prior art.

Written Description Rejection

Many of the claims, including independent claim 16, have been rejected as failing to comply with the written description requirement. The Examiner specifically noted the limitation in claim 16, "wherein said photodetection unit determines a level of product within said container, based on a quantity of said detected scintillating photons."

Applicants have amended the specification in accordance with this rejection, specifically the paragraph that begins on page 2 at line 26. That paragraph already discussed two earlier US patents, including US Patent No. 6,198,103, by Houillion. This Houillion patent has a FIG. 1 that clearly shows a level detecting system using a radiation source **18**, that irradiates a product **16** that is contained within a rotating basket **14**. The level detector comprises a bundle **12** of scintillating optical fibers arranged about the periphery of the rotating basket **14**. The optical fibers of bundle **12** produce scintillating photons that are detected by a photomultiplier tube **20**, and the amount of these photons gives an indication of the quantity of material **16** within the basket **14**. (*See*, column 1, lines 29-47; column 2, line 64 through column 3, line 4; column 3, lines 23-24; column 4, lines 21-28; and column 4, lines 42-47.)

In the amended paragraph of the instant application's specification, Applicants have added the following language that is based on this Houillion patent:

In these detector systems, the radiation source is positioned outside the container, the scintillation detector is positioned outside the container, and the product having its level being detected is within the chamber, as illustrated in FIG. 1 of the above-noted U.S. Pat. No. 6,198,103. The quantity of radiation received by the scintillation detector is an indication of the level of the product within the container.

No new subject matter is being added by this amendment to this paragraph of the specification, since this information was clearly disclosed in this prior art patent which itself was discussed in the Background of the Invention of the instant application.

Prior Art Rejections

In the above-identified Office Action, the Examiner rejected claims 16-18 as being obvious in view of Martin (US 3,717,760), in view of Seigmund (US 5,266,808), and in view of Kaminskas (US 3,501,632). It is apparent that the Kaminskas patent is not really directed to claim 16, since the Examiner used Kaminskas for its disclosure of flexible light pipes enclosed by aluminum tubes or the like, and the Examiner stated it would be obvious to seal a tubular member and to provide an opaque, flexible protective sheath substantially surrounding the tubular member of the detector of Martin. This comment thus appears to be directed at claim 17, rather than claim 16.

In view of this, claim 16 has been rejected as being obvious essentially in view of the combination of Martin and Seigmund (but not Kaminskas).

Discussion of the Cited Art

Martin

The Martin patent discloses a "radiation fill gauge" that uses a source of radiation inside a tank or "vessel" of a space vehicle to direct radiation in all directions toward the walls of the vessel of this space vehicle. A plurality of radiation detectors are mounted on the walls around the outside of the vessel and respond to the radiation passing through "stored material" within the vessel. In general, this material is some type of liquid, such as liquid fuel (or propellant) that is stored in a fuel tank (i.e., the "vessel").

Since the Martin patent has a use for measuring propellant stored in tanks of space vehicles, one of the objects of the Martin invention is to be able to determine the volume of the propellant of space vehicles in the absence of gravity. Without gravity, the volume of material within the tank (or vessel) will likely have an irregular spatial distribution, and therefore, the Martin invention is designed to determine the total volume of the liquid fuel, irregardless of the shape or places within the tank that this liquid fuel has accumulated.

To do this, Martin describes two separate embodiments. The *first embodiment* uses a single source of radiation that is positioned substantially in the center of the vessel, and in which the vessel is partially filled with stored material (e.g., liquid fuel or propellant within a storage tank). This single source will emit radiation, such as beta or gamma radiation, toward all of the walls of the vessel. The radiation field outside of the vessel will vary in strength depending upon how much stored material is interposed between the radiation source and the wall of the vessel. As noted above, the radiation detector is to be omnidirectional, so that the radiation will be directed to all points of the tank/vessel, and therefore, any liquid fuel left in the tank at any location will intercept some of this radiation. The detection scintillators are located all around the tank, as illustrated in FIGS. 2 and 3, and any liquid material within the vessel/tank will cause some of the radiation to be absorbed, and the detector will receive a lower amount of such radiation because of that fact.

The *second embodiment* of Martin uses a "dispersed source" for the radiation. In this embodiment, there is not a single radioactive device that generates gamma radiation, but instead a radioactive material (or mixture) is injected into the tank/vessel as a pressurant is introduced. The radioactive material itself becomes the radiation source, and as it decays, the radioactive material will generate gamma radiation. In this second embodiment of Martin, the radioactive material will essentially reach every space within the tank that is not filled by the liquid fuel, and the amount of radiation received by the scintillator sensors will depend upon how much of this "ullage" space that is not occupied by the stored material (i.e., the liquid fuel).

It is important to note that the Martin device is a *volumetric* detector, not a level detector. This is discussed in the "Objects" of Martin, starting at column 1, line 65. It is also stated in most of Martin's independent claims.

Seigmund

The Seigmund patent discloses a particle detector and method for using a helical array of scintillators. More specifically, Seigmund detects the passage of energetic ionizing particles travelling through a matrix of scintillating materials, such as plastics, glasses, or liquids. In one form of scintillating detectors, an array of parallel minute glass tubes that are filled with a scintillating liquid are used. Such arrays can contain several thousand or even tens of thousands of minute capillaries ranging in size from 5-100 microns. (See column 1, lines 25-27.)

The Seigmund device is not a level detector, but instead tracks the movements of a particular type of particle that is energetic enough to create the scintillating effect in the minute capillaries. Since there is an array of these capillaries, the energetic particle will intercept more than one of those small tubular capillaries, and by detecting which of the capillaries is impacted by a particular particle, the "track" (or path) of the particle can be determined by measuring the angle between the track and the line of flight of the particle. Using this information, the point of entry of the particle can be calculated.

The Seigmund device is strictly a single particle detector, in that it can only measure *for one particle at a time* its intended result of determining the track and point of entry of that particle. If multiple energetic particles, or multiple photons of energetic (or "scintillating") radiation, were to intercept more than one capillary in real time, then the Seigmund invention would be useless. Therefore it would not be able to function as a level detector in the same manner as the other types of level detectors that are in the field of technology of the present invention. In essence, the Seigmund device is directed toward particle physics research, something like a cloud chamber. It is not an "industrial" product level detector that could be used for measuring large masses of material.

Discussion of Independent Claims

Claim 16

Claim 16 is for a level detecting device, and as such is quite different than the Seigmund

prior art. Seigmund is a very specific device that can track the path of flight of a single particle that intersects more than one of the small capillaries that have scintillating material contained therewithin. Seigmund would be useless as a level detector that works on a principle of detecting a "quantity" of scintillating photons since, during a given moment (or small sampling interval), Seigmund is only useful to detect a single particle that intercepts an array of multiple capillaries. However, the present invention does not use an array, but only uses a single "flexible tubular member" that contains the scintillating liquid. The present invention thus does *not* attempt to determine the *path* of any of the radiated photons in the gamma radiation spectrum, for example. Instead, the present invention only determines the *quantity* of scintillating photons, and can determine the product level in a container based upon that measurement.

The Martin invention is more pertinent with respect to the subject matter of claim 16, since it at least detects a *quantity* of scintillating photons, which Martin uses to determine the volume of a "stored material" within its tank/vessel. However, the Martin invention is aimed at use in a weightless environment, and determines the volume of the stored material irrespective of the shape or location of that stored material within the tank/vessel. In column 5, lines 29-33, Martin states:

> The combination of the interior radiation source and 4π detector insures that fuel volume is accurately measured regardless of how it may orient itself in the tank. In zero-g space flight, the spatial distribution may be quite random and unpredictable. The preferred light pipe construction enables the immediate integration of ullage field data while at the same time providing a compact simulated 4π detector.

This arrangement is quite different from the present invention of claim 16.

Furthermore, Martin requires a detector system that can sense the stored material in *three dimensions*, since as noted above "the spatial distribution may be quite random." Therefore, Martin requires multiple detectors, as discussed in column 2, starting at line 64 (in reference to the "first embodiment" of Martin). In addition, to correctly function the structure of Martin's FIG. 1 actually will need to be duplicated, since the tank/vessel extends in a third dimension (not seen in these views), as discussed in Martin at column 3, lines 17-24.

This third dimension is also going to exist for the "second embodiment" of Martin, in which

a light pipe **34** is used, or a tube **44** filled with scintillating liquid. Therefore, multiple light pipes or liquid-filled tubes will be needed to detect a volume in three dimensions. Martin does not discuss it, but a "sheet" of scintillating detectors would give the most accuracy in his invention.

The present invention only "needs" a single level detector device, and that single device will operate properly in a *single dimension*. Although the "elongated flexible tubular member" of claim 16 is (of course) a three-dimensional object in reality, the point being made here is that this "elongated flexible tubular member" only needs to work in a single dimension (or "direction"), i.e., "up" and "down" (a vertical direction) to measure a product level within the container. And the accuracy of the present invention will not be impinged by the fact that its placement only needs to take into consideration that single dimension. This is a significant difference as compared to the volumetric measuring apparatus of Martin.

To reiterate: in claim 16 of the present invention, a "level" of a contained product is being determined, not a volume. If the container was "half full," then the present invention would properly "see" that half-full level so long as the radiation source and scintillating detector were correctly oriented to "see" that half-full level within the container. However, if the container was in a weightless environment, then the stored material within the container of claim 16 could easily be completely shifted along either the "left side" or the "right side" of the container, and the entire scintillating detector might be "covered" by such stored material. In that situation, the "level of product within the container" could not be determined with any accuracy; or possibly there would be no measurable output whatsoever from the detector, and thus the level would be completely indeterminate (or the tank would merely measure as "full"). Because of this, Applicants respectfully submit that Martin is not so similar to the present invention of claim 16.

The Examiner combined Seigmund with Martin to show that a tube of scintillating liquid could be sealed on both ends. (See page 4 of the above-identified Office Action.) Applicants do not dispute that Seigmund discloses sealed capillaries, which are very small but still may contain a scintillating liquid, perhaps similar to that of the present invention. However, the Examiner is mainly relying on Martin in the rejection of claim 16, and Martin clearly discloses a "volume detector," while claim 16 specifically is described as being a detector used for sensing a *level* of a

product, both in the preamble and in the last paragraph of the claim.

As can be seen in the above arguments, a "level" detector does not work just like a "volume" detector, and one cannot function like the other with respect to the end results, which are represented by an output signal. There may be some similar components in both level and volume detectors, but certainly there also are other differences. In view of the arguments presented above, Applicants respectfully submit that the combination of Martin and Seigmund does not render claim 16 obvious, and request reconsideration by the Examiner on this point.

Claim 19

Claim 19 has been newly added by this Amendment, and depends from claim 16. Claim 19 adds another element: a radiation source that is positioned "exterior of said container." This physical configuration is similar to the Houillion prior art patent, US 6,198,103, in which FIG. 1 clearly shows a radiation source **18** that is to the exterior (or outside) of the tank or container **14**. Houillion is discussed in the Background of the Invention of the instant application.

This new limitation in claim 19 is clearly the *opposite* of the teachings of Martin, in which the radiation source must be within the vessel/tank that contains the stored product (e.g., the liquid propellant or rocket fuel). Since claim 19 is essentially the opposite of the teachings of the primary reference used against claim 16 in the above-identified Office Action, Applicants respectfully submit that claim 19 should be patentable in view of the cited prior art.

Claim 20

Claim 20 is another new claim added by this Amendment that depends from claim 16. In claim 20 the "tubular member forming the scintillation chamber" has a limitation in which its inner diameter is "at least 0.25 inches (0.635 cm)" in size. This limitation is supported in the specification of the instant application on page 4, lines 31-34.

This new minimum diameter limitation clearly takes the present invention of claim 20 outside the teachings of Seigmund, which uses a large number of very small capillary tubes in the form of an array. In fact, an array of sensors is the only way that Seigmund can possibly work, since

it is designed to intercept an energetic particle with several of the individual capillaries, and from the scintillating photons generated in those individual capillaries, it determines the track or "flight path" of that radioactive particle. The present invention is not concerned with the track of a single radioactive particle, and thus is a very different invention.

In view of the differences discussed above, Applicants respectfully submit that claim 20 is not obvious in view of the cited prior art combination.

Dependent Claims

Claims 7, 11, and 17 have been amended to correct some informalities, on the recommendation of the Examiner. These claims all depend ultimately from claim 16, and if claim 16 is allowable, then these dependent claims (as well as others) should also be allowable.

New claims 19 and 20 both depend from claim 16, and were discussed separately in the arguments made above. Both of these claims depend from claim 16, and if claim 16 is now considered allowable, then these two claims should be patentable as well. In addition, claims 19 and 20 both have new limitations that were discussed above individually, and if claim 16 is not considered allowable by the Examiner, then claims 19 and 20 should each be considered on their own individual merits. These two claims can easily be put into independent form, if it turns out that they contain allowable subject matter, and if claim 16 ultimately does not.

Conclusion

Claims 7, 11, 16, and 17 have been amended to obviate an indefiniteness rejection by the Examiner. These claims have been modified in a manner as suggested by the Examiner.

New arguments have been presented for claim 16, and based on those arguments, Applicants respectfully request reconsideration of its patentability by the Examiner.

New claims 19 and 20 have been added by this Amendment.

There should be no fees associated with this amendment. However, the Director of Patents and Trademarks is hereby authorized to charge any underpayment of fees incurred due to this amendment to Deposit Account No. 50-2116.

Applicants respectfully requests the Examiner to favorably reconsider and allow the pending claims.

Respectfully submitted,
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